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Singapore's vision of a smart nation

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Singapore's Vision of a Smart Nation

Thinking big, starting small and scaling fast.

By Foo See Liang and Gary Pan

With a population of 5.4 million and land area of 718 square kilometres, 94 percent of Singapore's population live in high-rise apartments, of which, 82 percent dwell in public housing.[1] As an ultra-dense city-state, effective and innovative urban development is a social and economic imperative intricately intertwined with Singapore's competitiveness and quality of life. Harnessing information and communications technology (ICT) is not only essential to achieving this, but also serves as a template for answering some of the global challenges faced by urban centres around the world–particularly in regard to economic development, social cohesion, better city administration and infrastructure management.

Governments around the world are recognising the opportunities and benefits associated with smart city initiatives as a means to address denser, more diverse and growing urban populations. Singapore is unique in that it has been engaged in what could be considered 'smart city initiatives' since the 1980s. Its smart nation model places

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people at the centre of four enablers: governance, manpower, partnerships and technology. Lessons from Singapore's experience in national ICT planning, as well as its current endeavours to create a smart nation, may serve as important guidelines for urban policymakers and practitioners in countries and cities around the world.

What is a smart city?

There are many interpretations of a smart city. The European Commission articulates a smart city to be a "...place where the traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses...The smart city concept goes beyond the use of ICT for better resource use and less emissions. It means smarter urban transport networks, upgraded water supply and waste disposal facilities, and more efficient ways to light and heat buildings. And it also encompasses a more interactive and responsive city administration, safer public spaces and meeting the needs of an ageing population...In smart cities, digital technologies translate into better public services for citizens, better use of resources and less impact on the environment."[2]

Smart cities require a certain level of sophistication in ICT infrastructure, standardised network processes, and shared goals amongst public and private stakeholders. A fundamental pillar of building any smart city is intelligent and integrated city planning, where technology is incorporated into a city's physical, social and business infrastructure. This requires strong alignment among stakeholders, which may be contingent, in many cases, on long-term political will. The Singapore approach underscores the importance of the government taking the lead to position the country as a leading global city with a corresponding high quality of life, by effectively formulating and executing new smart city initiatives.

Singapore's Smart Nation platform

The first national IT plan was formulated in 1980. Since then, six master plans have been executed to bring Singapore closer to achieving its vision of becoming an 'intelligent island'. The 1980 inaugural infocomm master plan focused largely on a national computerisation programme for government agencies. Subsequent programmes concentrated on extending computerisation and connectivity to the private sector, while also connecting people–and the island itself–to the broader world. These programmes brought significant economic benefits and gains in the efficiency of service delivery. In 2015, the government announced the 'Smart Nation Initiative' with an aim to see Singapore become the world's first smart nation by 2025, and also further enhance networked computerisation capabilities in order to remain globally competitive.

Singapore's notion of a smart nation is based on its ability to gather data, interpret it, glean insights and then translate those insights into meaningful action. The Smart Nation Platform (SNP), spearheaded by the Infocomm Development Authority (IDA), Singapore's ICT development agency and regulator, is thus built around three focus areas: *Connect, Collect, and Comprehend* (refer to Figure 1). It will further enhance Singapore's capabilities in pervasive connectivity by building new and scalable infrastructure along with common technical architecture to support a smart nation ecosystem.[3] The plan includes developing a Smart Nation Operating System (SN-OS), which can be thought of as being equivalent to a computer operating system. It seeks to

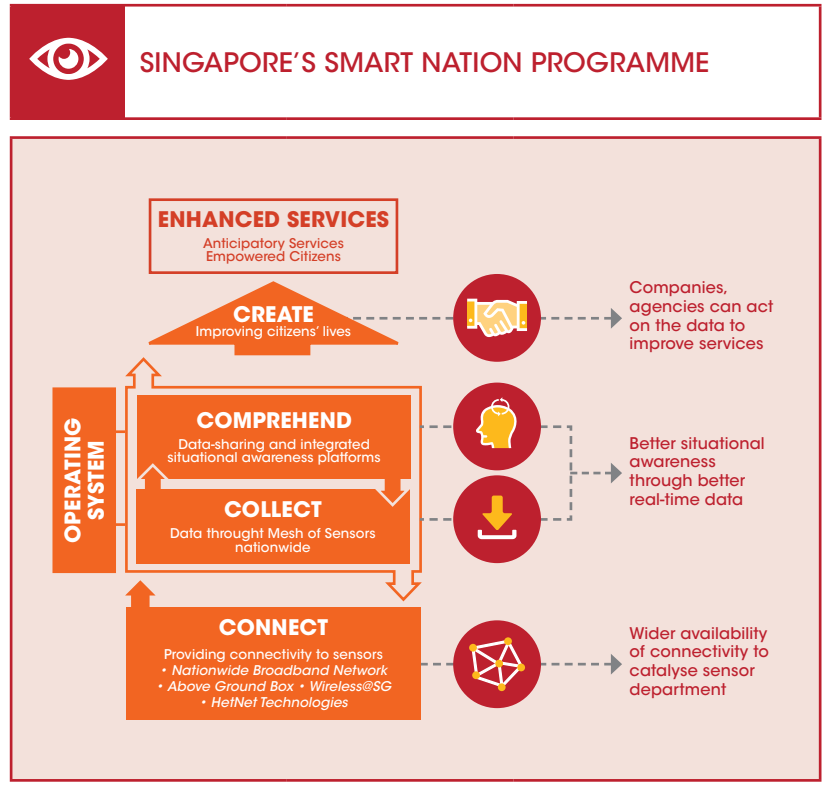

FIGURE 1 *Source: IDA Singapore, Media Fact Sheet: Smart Nation Platform. April 2015.*

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connect sub-systems of the nation to facilitate the creation of an integrated common picture for better situational awareness. For example, given Singapore's growing ageing population, SN-OS aims to implement user-friendly sensors in the homes of the elderly. Caregivers and healthcare providers can then monitor the aged and respond better, given the advanced knowledge captured by the system.

A fundamental prong of the SNP is the development of better situational awareness through real-time data collection and efficient sharing of collected sensor data. In October 2014, the Singapore government announced that around 1,000 sensors would be installed throughout the island to track anything from air quality and water levels to public safety. The sensors connect to Aggregation Gateway boxes that will be installed at traffic intersections, parks or bus stops, which will then send the data from surveillance cameras or air quality sensors back to government agencies for analysis.

In that same month, the IDA launched the Data-as-a-Service (DaaS) pilot to connect data users with private data providers in order to enrich the data ecosystem. According to Steve Leonard, Deputy Chairman of IDA: "To tackle difficult urban challenges in areas such as healthcare and energy, we need to capture and analyse massive amounts of data, and use that situational awareness to take meaningful actions... Our goal is to challenge ourselves to keep finding new ways to better use data to serve citizens of all ages."[4] In Leonard's view, "We cannot have a smart nation unless we can find ways to use data innovatively."[5]

Data providers can now participate in the DaaS pilot to increase the public visibility and availability of their datasets, and also understand and check its relative quality through a set of Data Quality Metrics. To enhance the bandwidth for the DaaS pilot, IDA has signed a Memorandum of Intent with Amazon Web Services (AWS) to provide cloud computing services to the first 25 data providers when they sign on to the pilot via AWS.[6] SNP thus aims to leverage Big Data analytics.

Some examples include data-driven smart nation applications in healthcare, such as the management of hospital bed shortages and availability of patient transportation. Another major initiative called 'Virtual Singapore' aims to develop an integrated three dimensional map of Singapore enriched with layers of data about buildings, land and the environment that is publicly available and compatible with the SN-OS.[7] Rich geo-spatial data such as this could have numerous benefits to both governments and businesses. For example, urban areas could be better designed to capture air currents that would keep outdoor spaces more comfortable in Singapore's hot tropical climate, and businesses could better plan their locations based on people flows. However, the most profound innovations are yet to be realised.

The pilot initiative

In collaboration with numerous planning, development, land-use and transport agencies, regulators and statutory boards, the IDA has launched the Jurong Lake District (JLD) smart township pilot initiative. Located in the western region of Singapore with a population of about one million, the JLD will serve as a live test bed for smart applications that would eventually be scaled up to a national level.

Recognising that, faced with resource constraints, city managers will have to rely on a larger suite of tools to monitor the environment and enforce

public safety, one JLD pilot project includes the capture and sharing of real-time environmental information such as temperature, relative humidity and air quality. This then feeds into an automated system that can, for example, in conjunction with advanced video sensing technologies, detect people smoking in prohibited areas.

While caring for the elderly is a societal goal, it is an increasingly expensive proposition. Moving away from a model centred around regular physician visits to one in which the elderly can be monitored, consulted or even treated in their homes has promising financial outcomes that make better use of resources with increasing benefits to society. Scheduling regular physician visits is often not needed, and clogs the offices of healthcare workers. In addition, it is often inconvenient and costly for patients and their family members. The Smart Elderly Monitoring and Alert System (SEMAS) is thus another initiative, which allows caregivers to remotely watch over the elderly by providing non-intrusive regular monitoring through in-home sensors that collect and compare data on the elderly person's routine based on a pre-set profile. When the system detects deviations from the profile, for example when the elderly person suffers a fall and is unable to get up, SEMAS will notify the caregiver. This reduces the need for costly and unnecessary physician visits.

In the broader area of healthcare, patients will no longer be required to visit clinics and hospitals for minor tests and monitoring. Rather, the monitoring can be done continuously from home via smart devices that can measure blood pressure, heart rate or other vitals and send the statistics to doctors using mobile technology. This also allows patients to consult doctors remotely. Collaboration between public and private entities will be essential for this to work.

Ensuring a successful smart city transformation

Singapore has identified five key factors for a successful smart city transformation.

DYNAMIC GOVERNANCE

Dynamic governance is defined as, "a governance system's ability to remain relevant and effective by continuing to change, innovate and adapt to new and emerging needs in a changing environment. The capacity and capabilities to change, in short, dynamic governance, are crucial for sustained and sustainable growth and e-development."[8]

Three critical governance capabilities are necessary for considering major policy issues and taking effective action: "First, thinking ahead–the ability to perceive early signals of future developments that may affect a nation in order to remain relevant to the world; second, thinking again–the ability and willingness to rethink and remake currently functioning policies so that they perform better; and third, thinking across–the ability and openness to cross boundaries to learn from the experience of others so that new ideas and concepts may be introduced into an institution."[9]

This mantra of thinking is further expanded by Singapore's smart city initiative, which propagates the notion of anticipatory governance. For example, the government can manage change through intelligent decision-making supported by 'smart' data gathered through its position at the centre of the information ecosystem.

TECHNOLOGY

Singapore developed its IT capabilities over several decades through strategic investments in computing infrastructure. Such capabilities include an extensive and continuously developed IT infrastructure, competencies in identifying and providing efficient integrated electronic services, and continued investment in developing the IT capabilities of both service providers and users throughout Singapore. On IT infrastructure, the World Economic Forum ranks Singapore as one of the most network-ready countries in the world.

MANPOWER

The IT infrastructure and networks would have been inconsequential without the skills to quickly build and apply IT solutions. The foundation for 'soft infrastructure' or IT manpower was firmly established in the earlier ICT Masterplans. Literacy, including a high emphasis on computer-based skills education, helps prepare students for the digital economy and future employment. Accompanying the involvement of the community groups and schools, significant investments were also made to support specific adoption programmes among low-income households and late adopters of ICT.[10]

PARTNERSHIPS

Given the SNP's scope, complexity and pervasiveness in its impact on every strata of society, multi-government agencies and public-private sector collaborations are essential to its success. Singapore has established a network of inter-organisational IT expertise across both the government and private sector. The collaboration of various experts has helped achieve a build-up of technological capability in Singapore with technology transfer from its partners. Such collaboration is important in helping to bring IT expertise to the next level.

Partnerships are formed through formal contracting and mutual dependency, when one organisation has to rely on another's dominant technological architecture or brand that offers value to the ecosystem, or other factors such as product characteristics or geography. Collaboration is one of the key enablers recognised by the IDA in Singapore's SNP. An integral part of this initiative is the Call for Collaboration for all key stakeholders to contribute to the success of the initiative.

The collaboration model adopted by the government comprises two forms: public-public partnerships and public-private partnerships. As a public-public partnership, Singapore's largest government ICT research institute, Agency for Science, Technology and Research (A*STAR), spearheads research in collaboration with a wide spectrum of stakeholders. In the JLD test bed project, one A*STAR initiative involved working with the Land Transport Authority to develop a next generation public transport system focused on improving the commuter experience. Under the public-private arrangement, Singapore's government agencies collaborate with corporations to co-research and/or co-innovate. These corporations comprise multinational corporations, local globally competitive companies, and small and medium enterprises.

At the heart of Singapore's ICT journey is its culture of innovation and experimentation. Innovation is about risk-taking. 'Cautious experimentation' of new concepts and ideas before going 'live' is a common characteristic of Singapore's success. It is common to see the government of Singapore taking the lead while the private sector and civil society supply the know-how and citizen feedback respectively. This 'tripartite collaboration' model ensures that all key stakeholders in the value-chain are engaged in the process of realising desired outcomes.

PEOPLE

A smart city is purpose-driven to enrich the living and working standards of its inhabitants. The Singapore approach is people-centric as there is comprehensive engagement of key stakeholders—that is, its citizens, businesses and government agencies—involved in all phases of smart city development. The JLD test bed, for instance, also includes mechanisms for obtaining feedback from citizens and business collaborators on what worked and what did not work to arrive at incremental and appropriate solutions.

Framework of Singapore's smart city transformation

Singapore's model of a smart nation is thus driven by three key themes: innovation, integration and internationalisation (refer to Figure 2).

ICT provides a wide innovation platform that enhances Singapore's ability to stay abreast of other alpha cities–such as Hong Kong, Tokyo, London and New York–by creating areas of excellence in governance, partnerships, technology and manpower. This is supplemented by the government's current push to harness Big Data and data

FRAMEWORK OF SINGAPORE'S SMART CITY TRANSFORMATION

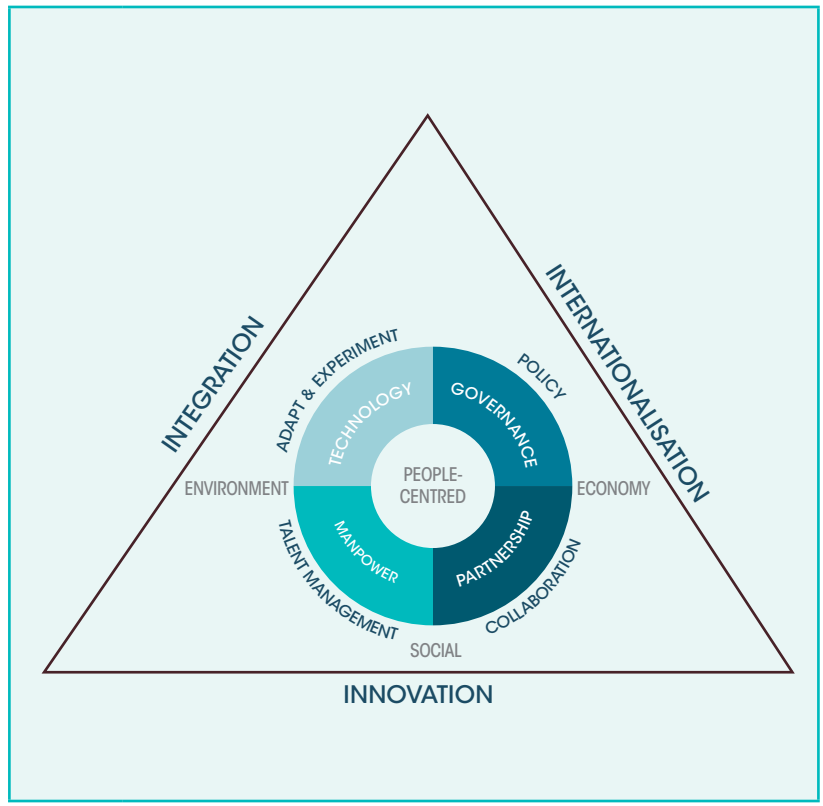

FIGURE 2

analytics for innovative decision-making and adaptive planning. Integration of platforms across government and businesses is an enabler of information accessibility, coordinated service offerings and interaction among stakeholders.

The current boundary is linking data users and data providers with the purpose of developing applications to aid in such decision-making. The nation-wide network of sensors that are being built will drive data on externalities to be harnessed for personal and business applications. For instance, smart car parks help optimise parking space usage by monitoring demand patterns of residents and visitors. Lastly, the smart nation initiative should enhance Singapore as a global hub for business and position the country as a smart city brand, renowned for its ICT expertise. This can be leveraged to build bilateral relationships overseas. For example, Singapore is leading initiatives in building smart cities in China while India has recently expressed interest in tapping into Singapore's knowledge and experience for its own smart city initiatives.

Lessons learned

Today, Singapore is well on its way to fulfilling its vision of being the world's first smart nation. Its story provides a useful template to reflect on the key lessons that can be drawn from this experience.

Firstly, the journey relied on political consolidation and committed leadership to lead, adapt and sustain the endeavour. The status quo is not an option, and the government must be ready to take the lead on managing change. For Singapore, this attitude became particularly apparent in the 1980s when it began laying the groundwork for the island's ICT infrastructure to be future-ready by anticipating and preparing for long-term trends.

Secondly, the vision, outcomes and goals must be clearly communicated to all stakeholders. These are laid out publicly in the country's master plans, which help to align goals and expectations. Moreover, the master plans lay out what capabilities are necessary to identify targets and execute these problem-solving initiatives with measurable impact.

Thirdly, the importance of stakeholder engagement and collaboration cannot be understated. The scale of the smart city initiative is too large and complex for any single agency to undertake on its own. More importantly, it impacts every facet of society.

Last, but not least, it is always useful to 'think big' but 'start small and scale fast'. It is about taking small yet bold steps forward to stay ahead. Perhaps the most subtle lesson is the importance of experimentation, exploratory learning and reflection on failures, as they provide the catalysts for innovation, and the foundation of establishing a smart nation.

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References

1 Singapore Department of Statistics.
2 European Commission, "A Digital Agenda for Europe: A Europe 2020 Initiative (Smart Cities)".
3 iN.SG, "Singapore Lays Groundwork to be World's First Smart Nation", June 18, 2014.
4 IDA, "First-Ever Smart Nation: Data Works Opens with New Data-as-a-Service Pilot", October 28, 2014.
5 iN.SG, "Discovering Innovative Ways of Dealing with Unstoppable Forces", November 20, 2014.
6 IDA, "First-Ever Smart Nation: Data Works Opens with New Data-as-a-Service Pilot", October 28, 2014.
7 Prime Minister's office, Singapore "Transcript of Prime Minister Lee Hsien Loong's speech at Smart Nation launch". November 24, 2014.
8 Jeannie Chua, "The e-Transformation Journey of Singapore", In "National Strategies to Harness Information Technology, Innovation, Technology, and Knowledge Management", N.K. Hanna and P.T. Knight (eds.), 2012 Springer Science Business Media, LLC. p64.
9 Boon Siong Neo and Geraldine Chen, "Dynamic Governance: Embedding Culture, Capabilities and Change in Singapore", World Scientific Publishing, 2007, p 3.
10 Jeannie Chua, (Ibid).